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BULLETIN

OF THE SOCIETY OF ARTS

FEBRUARY, 1910

667th Meeting
February 9th

Dr. Harvey W. Wiley, Chemist of the United States Department of Agriculture, Bureau of Chemistry, Washington, D.C., on "The Services of Chemistry in the Promotion of the Public Welfare," Huntington Hall, Wednesday evening, February 9th, at 8 o'clock. Thirty years ago Dr. Wiley made up his mind that one of the most serious menaces to the welfare of this nation was the steadily increasing adulteration of its food products, and that the interests profiting by such abuse were powerful enough to make the fight against them a hazardous proposition. For more than a quarter of a century he has been fighting without remission for pure food, and it is largely through his efforts that the enactment of the pure food law became possible. It is enough to say of him that the French government has decided to reproduce the entire system of food inspection and laboratory work established by Dr. Wiley in this country. He is a forceful, agreeable public speaker.

668th Meeting
February 23d

Professor Henry P. Talbot, in charge of the Department of Chemistry and Chemical Engineering at the Institute of Technology, on "The Chemistry of Modern Illuminants," at the Chemical Lecture Room, No. 6 Lowell Building, on Clarendon Street near Stanhope Street, Wednesday evening, February 23d, at 8 o'clock. Professor Talbot will give a non-technical account of the sources and preparation of the materials employed in the modern systems of household illumination, and the nature of the products which, in many cases, escape into the atmosphere of our rooms. Candles, burning oils, illuminating gas, acetylene, and incandescent mantles will be included in the discussion of the evening, which will be illustrated by experiments and lantern slides.

THE SOCIETY OF ARTS OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

The Society of Arts was established as a department of the Institute by President Rogers in 1861.

It is especially devoted to the general dissemination of scientific knowledge, and it aims to awaken and maintain an interest in the recent advances and practical applications of the sciences.

Any person interested in the aims of the Society is eligible to membership.

The annual dues are $3.

EXECUTIVE COMMITTEE

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I. W. LITCHFIELD, Secretary, Massachusetts Institute of Technology, Boston.

DR. WILEY AND HIS WORK

On account of his many engagements it was impossible for the Society to secure Dr. Wiley's presence last year. He has, however, consented to appear before the Society on Wednesday, February 9th, subject to the exigencies of the public service. It is doubtful if any public servant has attracted more attention or has aroused more general sympathy with his work than Dr. Wiley, and the amount of good that he has accomplished in the face of almost overwhelming obstacles is marvellous. A writer in the January number of the *World's Work* says:—

"When Dr. H. W. Wiley entered the Bureau of Chemistry of the Department of Agriculture as its official head, twenty-six years ago, he had four assistants and a dish-washer, and they did their work in the cellar of the Agricultural Building. Now he has a staff of about three hundred and fifty, about two hundred of them being chemists, and his laboratories are a credit to the Department. This long step in advance is in many respects the measure of the man.

"In regard to our ideas as to what is fit to be eaten by human beings and what is fit to be sold in shops and market-places, we have moved so rapidly ahead in a few years that we have almost forgotten the conditions which prevailed everywhere when Dr. Wiley first took office, and which largely continued even after he had begun his experiments. What they were, Dr. Wiley describes as follows:—

"'There was universal misbranding, universal exaggeration of qualities, and universal adulteration. Honest manufacturers were forced by fear of bankruptcy to follow the example set by the dishonest ones. Strawberry jam, for instance, was made of glucose, with artificial coloring, ethereal salt for flavoring, and a few seeds of hay to imitate the berry seeds. What was true of foods was also true of beverages and drugs. And the misstatements on the labels concerned not only the contents, but also the place of manufacture and the identity of the manufacturer. In those days there was nothing in the market but "Maine" canned corn and "New York" full-cream cheese. All whiskey was either "Maryland Rye" or "Kentucky Bourbon," although most of it came from Peoria, Ill., and was made from Indian corn. At the same time every conceivable kind of chemical was added as a preservative.'

"What it has already accomplished was recently summarized by Dr. Wiley as follows: 'It has stopped ninety per cent. of the misbranding; it has put a stop to fifty per cent. of the drugging of foods; and it has enabled honest manufacturers to discard what they knew to be dishonest practices.'"

THE CHEMISTRY OF MODERN ILLUMINANTS

Professor Talbot's lecture on February 23d will deal with a chapter from the chemistry of common things. It will tell a simple story in a simple fashion, designed to give the non-chemical hearers an idea of the sort of materials used in our modern lamps and gas flames, where they come from, and what becomes of them in the process of light production. Incidentally, the influence of these products upon the air of our living-rooms and those who inhabit them will be touched upon. The range from the candle to the acetylene flame or the incandescent mantle presents an interesting variety of topics, of which the preparation of the mantles themselves is not the least interesting.

The lecture will be illustrated by many experiments, which by their very nature lend themselves readily to the illustration of an evening talk, and lantern slides and specimens will also be freely exhibited. The lecture is given in the Chemical Lecture-room, in order to utilize facilities for experimentation which it is not practicable to obtain in other halls of the Institute.

NEW MEMBERS OF THE SOCIETY OF ARTS

At the meeting of the Society, held January 12th, the following applicants for membership were presented and elected:—

F. C. Henderson, 263 Clinton Road, Brookline, Mass.
William E. Schrafft, 16 Charlestown Bridge, Boston, Mass.

W. C. Hunneman, 94 Colchester Street, Brookline, Mass.
Charles W. Henderson, Jr., 374 Congress Street, Boston, Mass.
Charles E. Lord, 24 Milk Street, Boston, Mass.
Frank C. Spinney, 636 Beacon Street, Boston, Mass.
Edmund W. Longley, 318 Lafayette Street, Salem, Mass.
James E. Whitney, 6 Park Square, Boston, Mass.
A. G. Van Nostrand, 482 Beacon Street, Boston, Mass.

At the meeting of the Society, held January 26th, the following applicants for membership were presented and elected:—

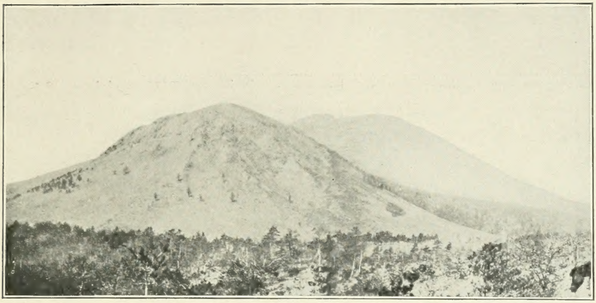
J. Chancellor Crafts, 77 Lanark Road, Brookline, Mass.
Samuel C. Lawrence, 8 Rural Avenue, Medford, Mass.
Geo. V. Leverett, 66 Beacon Street, Boston, Mass.

THE EXPLORERS AT THE MILL NEAR TARUMAI

The second from the left is Prof. Sato, next Prof. Oinoué, and Prof. Jagger in the order named. Mr. J. J. Kline is on the extreme right with Prof. Shimotomai at his right. The others are the Japanese host and his family.

JAPANESE VOLCANOES

On Wednesday, January 12th, Professor Thomas A. Jaggar, Jr., head of the department of geology of the Massachusetts Institute of Technology, delivered a lecture on "Japanese Volcanoes," richly illustrated with many beautifully colored lantern slides made on his journey of exploration to Japan last summer.



ASAMA VOLCANO, JAPAN

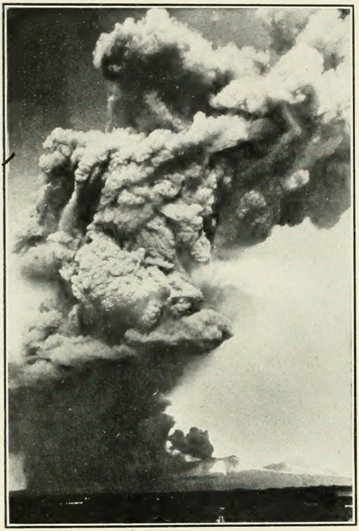
"Japanese volcanoes and volcanoes in general," said Dr. Jaggar, "lend themselves to a genetic classification treating them as the zoölogist treats the shell-fish. I believe that there are a great many inorganic process-made creatures of geology which are comparable with certain organic process-made creatures of zoölogy." Explaining his theory, Dr. Jaggar showed how from Kilauea in Hawaii, the oldest type of known volcano, to Fuji in Japan, the most recent type, geologically speaking, all the volcanoes of the earth are naturally classified into seven groups, according to the chemical composition of their lava, which has a direct bearing on their activity. From the older to the younger volcanoes the lava is graded from a liquid through various states of viscosity to solid rock as exemplified especially in Mont Pelée and Bogoslof in the Pacific. The more liquid lava is characteristically basic, while the solid is chiefly acidic (see page 11).

According to measurements made by Professor Jaggar and his associates, the liquid lava is no hotter than the solid at the time of eruption, the liquification being caused by the smaller amount of silicon in the composition which tends to stiffen the mixture of molten rock as cement is stiffened.

While Kilauea, with its flat, lens-shaped dome with a pit or top, gives continuous non-explosive activity with but little water evident in the lava, Vesuvius, belonging in the second class, erupts at short intervals with steam and explosive action, Asama throws out its viscous lava in spasmodic longer intervals, and so on through the other classes the intervals between eruptions becoming longer and the explosions more violent, less and less lava being extruded up to Soufrière in St. Vincent. Fujiyama, the seventh on the list of classification, is nearly extinct, most of its action going on far beneath the surface of the earth.

The new classification, based, as it is, on composition of lava, petrography, form of the crater and cone, and on the character of activity, promises to greatly facilitate the study of volcanoes and their action.

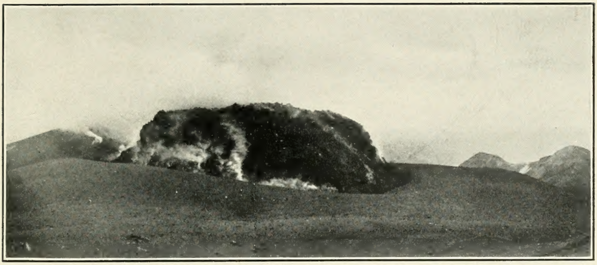
In speaking of Hawaii, Dr. Jaggar characterized it as an ideal spot for the study of seismic conditions, stating that he hopes to see established there soon a geophysical observatory under the direction of the department of geology at the Massachusetts Institute of Technology.



THE TARUMAI ERUPTION OF MARCH 30
Preceeding rising of dome.

"Japan," said Dr. Jaggar, "is a continental axis with one hundred and sixty volcanoes of various degrees of activity. Fujiyama is by all odds the most picturesque of these, its snow-clad height rising some twelve thousand feet above the sea-level, and being visible from all parts of Central Nippon. In Japan there is an excessive volcanic uplift, the ground rising about fifteen feet in a century, while in Boston it rises but one. The country is not more intensely seismic a land than the coast of Alaska and California, but the density of the population brings before the world every earthquake, while many take place in Alaska and California which pass unnoticed in the sparsely settled districts.

"It is this density of population which has made the earthquakes of Japan so terrible, and led finally to the Japanese government becoming the first and foremost in the world in the

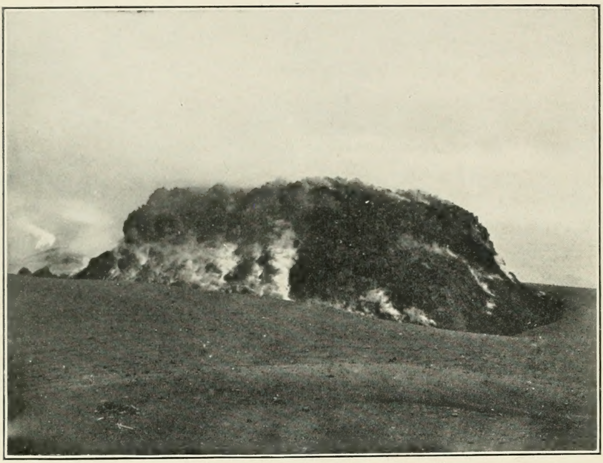


DOME OF TARUMAI

scientific investigation of earthquakes with a view to predicting them and lessening the horrors which they inflict."

In depicting the Gifu earthquake of 1891, which led the Japanese government to the establishment of its famous earthquake investigating committee at a time when the nation's treasury was already overburdened with an extensive naval programme and other expenses, Dr. Jaggar exhibited a series of the most remarkable pictures ever taken of an earthquake holocaust. The land in the Gifu district was shown shaken up as if in a vast hopper sixty miles in diameter, cracked and seared so that it subsequently had to be resurveyed. The peculiar characteristic of the pictures was the splitting of the roads, which on the banks of rivers seemed to be the weak points in the surface. Expert as the Japanese carpenters were in the construction of earthquake-proof houses, these light buildings were smashed and driven into the ground like so many matches. The photographs which were exhibited of this disaster were taken by the Japanese, and revealed realistically the sufferings of the wounded, the horror of the dead bodies, and the gigantic upheaval of the ground.

Following the earthquake, the Japanese commission began its work with something like $15,000 a year, the professors of the universities, of which the commission was made up, led by Professor Omori, of the University of Tokio, giving their services without recompense. Specialists in magnetism, physics, and chemistry, bent their endeavors to the task until Tokio has the most expert force of seismologists in the world. Dr. Jaggar described the observatory which has recently been constructed there, equipped with instruments invented by the commission, for the registration of the seismic disturbances occurring in all parts of the world. "The Japanese are anxiously awaiting a



THE DOME OF TARUMAI

great earthquake in Tokio,'' he declared, "to test an earthquake-proof building they have constructed, with actual strong disturbances going on around it."

Leaving Tokio's remarkable apparatus, Dr. Jaggar carried his hearers inland with a series of artistically colored lantern slides, portraying the country and the life of the people to the edge of a high plateau where settled the town of Karuizawa in the shadow of Mount Asama capped with its soft white jets of steam. Here Dr. Jaggar turned from his subject to compliment the Japanese on their forestry service, which is doing a tremendous work in the symmetrical setting out of young trees all over the land.

Mounting the steep slope of Mount Asama, Dr. Jaggar and his party reached the crater of the volcano, a round pit one thousand feet across and three hundred feet deep, which is usually so filled with clouds of steam that its bottom is invisible. Japanese geologists had for years awaited the opportunity which came to the American. As the party reached the summit, the steam cleared away a sufficient time for photographing the depths of the crater, showing a swirl of hard molten lava on the bottom, surrounded on the sides by puffs of rising steam.

Crossing the channel northward to Yezo, the upper island of the Japanese group, the party visited Tarumai, whose curious eruption led to the solution of a formerly perplexing problem.

The Dome of Tarumai taken from northwestern side, showing steam issuing from fissures

Following warnings in the way of excessive spiral spurts of steam from the crater of the mountain, a slow eruption occurred of stiff lava. On April 18th of last year a bright glow was observed over the mountain, and between that date and the 23d a great dome was gradually pushed upward, rising five hundred feet high and one thousand feet in diameter, of hard rock with crevices discharging superheated steam.

In three days millions of tons of solid rock had been pushed upwards with the ease of a rising elevator. The dome was flat across the top, like a huge plug. To this form of eruption, hitherto rarely observed by scientists, Dr. Jaggar attributes the table-land islands of the Bogoslof group, which rose in 1883. Thus volcanic action has different methods of showing lava; for not only may mountains, like Vesuvius, break forth spasmodically, hurling death and destruction broadcast, but quietly and unobtrusively a mountain plug or an island may rise.

It was this eruption, too, that led Dr. Jaggar to his classification theory, for, after careful experiments with the electric pyrometer and thermo-couple, approaching as near as he dared to the dome, it was found that the temperature of steam on the outer crust was 458 degrees Centigrade. Apparently, by these measurements and those of Dr. Hovey made in 1902 and 1903 at Mont Pelée, viscous lava or solid lava rock give higher temperatures of water vapor than the liquid lavas.

A curious photograph of an incident of this eruption showed a snow cliff covered with a thin bed of lava gravel, directly over which were the clouds of steam and the vast hot dome. The mountain was covered with four feet of snow previous to its eruption, and the hot gravel thrown off from the eruption had been quickly cooled, effectively shielding the snow from melting.

The rock of the dome quickly eroded, and on the border huge blocks fell off.

Dr. Jaggar declared that many mountains with dome-like tops would doubtless now be found to be volcanoes which had risen like Tarumai, Bogoslof being typical of the class. He stated that the pencil-like pinnacle which rose within the crater of Mont Pelée after its eruption was pushed up in much the same manner as that in Yezo.

Concluding his lecture with a return to Hawaii, Dr. Jaggar exhibited a series of six colored slides of Mount Kilauea and other volcanoes in the order of the viscosity of their lavas. Looking down into the crater of this active volcano, the pit presents an orange, almost white-hot bed of undulating lava, pounding on the rocky shores and rolling like surf, while a brilliant light is radiated and reflected in the heavens. The other volcanoes show progressively harder lavas. The lecture was brought to a close with a striking picture of sunset on Fujiyama.

Type.	Lava.	Petrography.	Physiography.	Activity.	Probable Intrusions causing Elevation.	Superheat of Water Vapor.
1. Kilauea.	Liquid.	Basalt.	Flat lens-pit crater.	Continuous and no explosions, water scant.	Intrusives probably absent.	Measured at 300° C.
2. Vesuvius.	Viscous flows.	Leucite-tephrite.	Lens and caldera under cone.	Short intervals, lava and explosion.	Few intrusions.	Perret 323° to 438° C.
3. Asama.	Stiff low pile of block lava.	Pyroxene-andesite.	Cinder cone.	Intervals, explosion, some lava.	Elevated volcano, probably over-intrusives.	
4. Tarumai.	Rock dome.	Hypersthene-andesite.	Crateral dome or cone.	Spasmodic, long intervals, explosion dominant.	Elevated coast-line movements diagnosed.	458° C.
5. Pelée, Bogoslof.	Rock dome and spine.	Hornblende, pyronene, quartz andesites.	Spine and cumulo dome on ancient eroded cone.	Very long intervals, intense explosion.	Positive elevation during eruption (Bogoslof.)	
6. Soufrière.	None extruded.	Dacite-andesite.	Cone and crater lake.	Very long intervals, water abundant, great explosion, no lava.	Elevation, seismic area.	
7. Fuji.	Ancient only.	Recent acid tuff.	High cinder cone.	Nearly extinct, rare slight explosion.	Elevation and pronounced seismic disturbances.	
8. Henry Mts.	Lacco-lithic.	Monzonite, trachyte, rhyolite.	Volcanoes (?) on sea bottom.	Intrusion.	Mostly intrusive, causing local elevation above.	Probably much superheated water.

THE LECTURE BY PROFESSOR CROSS.

On January 26 Professor Charles R. Cross, head of the Department of Physics at the Institute of Technology, addressed the Society on "The Experimental Evidence for Modern Views as to the Nature of Electricity."

The speaker first called attention to the fact that a charged body, even when insulated perfectly, will, nevertheless, slowly lose its charge, this being due to a feeble accidental ionization of the air. This ionization can be produced strongly in various ways as by the action of flame, of ultra-violet light, of the Röntgen rays, of the radiations from radium. This action was illustrated experimentally, and it was shown that the processes mentioned produced in the air a certain structure, which persisted when the air was drawn through a tube, though it was destroyed if the tube was plugged with cotton wool. The structure in question is due to the production in the air of particles called carriers, ions, or corpuscles, which are developed in equal numbers positively and negatively electrified, and which, being very mobile, readily act to discharge an insulated body.

The nature of these carriers was first ascertained by a study of the so-called "cathode rays" which are produced in a vacuum tube when the exhaustion is of the magnitude of a millionth of an atmosphere or thereabout. These are seen as rays apparently projected in straight lines into the tube from the cathode or negative electrode.

They produce a luminescent glow of the residual gas in the tube, and cause a brilliant luminescence of the walls of the tube and of certain minerals, if these are placed within it. They produce strong heating effects. They are capable of ionizing the residual gas, are acted upon by a magnetic field and by an electric field, just as moving charged particles would be acted upon, and they carry a negative charge. They are capable of passing through extremely thin aluminum or gold foil. These and other characteristic phenomena of the cathode rays were demonstrated by vacuum tubes selected from the collection of the Institute, which is one of the finest possessed by any educational institution.

From the behavior of these rays in the magnetic and electric fields it follows that they are electrified carriers of a negative charge, which, as just stated, has been independently proved. From the fact that they pass through a metallic leaf it would seem that they must be extremely minute, and from their very energetic heating effect a high velocity would be inferred.

Knowing the strength of the magnetic and electric fields employed and measuring the deflections produced by them on the cathode rays, it is possible to determine both the velocity of the rays and the ratio of the charge carried by the particles to their mass. They have been found to travel with a speed about one-tenth that of light; that is, about 19,000 miles per second. The ratio of charge to mass was found to be about 1,700 times that of the ratio of the charge known to be carried by the hydrogen atom in the process of electrolysis, to its mass. From this it follows either that the charge carried by the ion or corpuscle in the vacuum tube is 1,700 times greater than that carried by the hydrogen atom or else the mass of the corpuscle is only 1-1700 that of the hydrogen atom. By a most ingenious process, based upon the rate of fall of a cloud produced in a mass of rapidly expanded air saturated with moisture and filled with negative corpuscles under the ionizing action of the X-rays or the ultra-violet light rays, the latter question was solved. The charge carried by the cloud was measured, the mass of water in the cloud was known from the amount of the expansion employed, and the diameter of the drops from their rate of descent. As there would be one drop to each corpuscle, the number of corpuscles became known, and hence by dividing the total charge as measured by the number of corpuscles thus ascertained the charge carried by each corpuscle could be found. The result showed that the charge is the same as that carried by the hydrogen atom, whence it followed that the mass of the corpuscles in the cathode rays is only 1-1700 that of the hydrogen atom, the smallest thing previously known. The negative corpuscles were found to be independent of the nature of the gas, and always of the same dimensions. Hence their charge constitutes a true natural unit of electricity.

The presence of positive carriers in the vacuum discharge is proved by the canal rays or positive rays which were next shown. These are deflected in the magnetic and electric fields, but oppositely in direction to the cathode ray corpuscles. They are found to move with about one one-hundredth of the velocity of light, and to have a mass comparable to that of the hydrogen atom instead of being so extremely minute as are the negative carriers.

The negative and the positive ions, however produced, are found to be of like character and dimensions.

Radio-active bodies produce ions of the same character in all respects with those produced in the vacuum tube. Various of these phenomena were experimentally illustrated, the luminescent and ionizing effect produced by radium and the action of a magnetic field upon the rays emitted by it being clearly manifest. By methods similar to those already described it has been shown that radium and like materials project into the air with explosive violence both positively and negatively charged particles, the so-called α and β rays. These have the same mass as the carriers present in the vacuum discharge. The velocity of the negative carriers, however, is enormously great, almost approaching that of light. Besides the α and β rays, a third kind, the γ rays are emitted, which like the X-rays are etheric disturbances similar to light waves, but irregular and merely pulsatory in character. Studies upon the β rays, whose velocity may have different magnitudes under different conditions, shows that their mass increases with their velocity, and in such a way as to indicate that they are wholly electric in their nature, the charge not being carried by ordinary matter. Whether positive electricity can exist apart from matter has not been finally shown, but there is strong evidence that the positive carriers are not necessarily merely atoms from which a negatively charged corpuscle has been removed.

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